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Evaluation of occupational health and safety practices in kindergartens from an engineering perspective: A case study from Turkey

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Abstract

This study aims to evaluate occupational health and safety (OHS) practices in preschool education institutions from an engineering perspective. The research examines the case of Balahatun Kindergarten, analyzing its OHS practices across the dimensions of risk assessment, physical environmental conditions, employee safety, and student safety. The findings indicate that safety in preschool environments must be addressed not only from a pedagogical standpoint but also through engineering-based approaches such as risk management, ergonomics, and system safety. Key findings highlight the importance of fire safety, emergency evacuation plans, the safety of electrical and mechanical systems, ergonomic provisions, and the continuous maintenance of hygienic conditions. The research further revealed that enhancing the occupational safety awareness of employees is as crucial as ensuring the safety of the children. In conclusion, the widespread adoption and standardization of engineering-based OHS practices in preschools are deemed critical for ensuring long-term safety and sustainability.

1. Introduction

Occupational health and safety (OHS) has become vital in the modern era, not only in industrial facilities but in all professional fields, including educational structures. Preschool institutions, in particular, require a much more meticulous safety approach due to the high degree of vulnerability of young children. Even the slightest safety deficiency in educational environments can severely threaten the health of both students and employees [1].

The Occupational Health and Safety Law No. 6331, which came into force in Turkey in 2012, mandates that all workplaces in the public and private sectors conduct risk assessments, prepare emergency plans, provide employee training, and undergo regular inspections [2]. However, the literature indicates that these regulations, especially in educational institutions, often remain at the level of administrative formality, with engineering-based solutions being implemented to a limited extent [3].

International literature also offers significant insights into this subject. Santa-Cruz et al. [4] emphasized that school safety must be evaluated not only technically but also within the scope of social sustainability in disaster-

prone contexts. Similarly, Farewell et al. [5] indicated that employee safety in preschool institutions is directly linked to child health and the learning environment. Furthermore, the European Union Agency for Safety and Health at Work recommends standardizing fire safety, ergonomics, HVAC systems, and evacuation plans in educational buildings [6].

One of the most critical issues in OHS practices is fire safety and emergency planning. Recent studies show that emergency preparedness in educational institutions requires systematic improvements. Tomluca et al. [7] highlighted the importance of fire safety in schools, while Kırtaş and Altundağ [8] argued that structured evacuation training models increase overall preparedness. Likewise, Schildkraut and Nickerson [9] confirmed that lockdown and emergency drills enhance readiness in schools, and subsequent studies by Schildkraut et al. [10] further revealed how educators' perceptions shape the effectiveness of such practices.

The safety of the physical environment is also one of the weakest links in preschool institutions. The failure to ensure the security of electrical and mechanical systems creates serious injury risks for children. This is where engineering-oriented solutions come into play. The study by Çelik [11] on the evaporator performance of environmentally friendly refrigerants shows that the correct fluid selection and system design directly impact not only energy efficiency but also safety risks. Similarly, the relationship between sustainability and safety is gaining importance in educational facilities. The study by Tirogo [12], examining the effect of tilt angle on the performance of PV panels, reveals that energy efficiency and electrical safety must be addressed concurrently through engineering solutions.

Moreover, ergonomics and employee health are significant issues in school environments. Prolonged work with unsuitable furniture can increase the prevalence of musculoskeletal disorders among employees and even negatively affect student interaction. Uyal and Umar [13] found that classroom environment strongly influences both student performance and musculoskeletal discomfort, while Ramírez-García et al. [14] highlighted the prevalence of musculoskeletal disorders among primary school teachers.

In recent years, the effects of climate change have also heightened the importance of OHS in educational facilities. Extreme heat waves, floods, and power outages are straining the safety infrastructure of school buildings. Feinstein and Mach [15] argued that education plays three central roles in climate adaptation, while Ramirez et al. [16] stressed the need for accountability in school emergency drills. In this context, structures equipped with high energy efficiency and passive safety systems have become a priority for sustainable safety.

All these findings from the literature indicate that OHS in preschools must be supported not only by administrative measures but also by engineering-based technical solutions. This study, through the case of Balahatun Kindergarten, addresses occupational health and safety from the dual perspectives of employee and student safety and aims to present a comprehensive evaluation from an engineering perspective.

2. Literature Framework

Although Occupational Health and Safety (OHS) has been extensively studied in the literature, mainly focusing on industrial sectors, healthcare, and construction activities, research on this topic within educational institutions has remained limited [1]. Yet, preschool institutions require particular attention from an OHS perspective due to the high degree of physical and psychological vulnerability of young children. Establishing a safety culture in schools necessitates not only protecting students but also safeguarding employee health [1, 3].

The Occupational Health and Safety Law No. 6331, currently in force in Turkey, also covers educational institutions and imposes obligations on employers such as conducting risk assessments, preparing emergency

plans, providing employee training, and carrying out periodic inspections [2]. However, research suggests that in practice, these obligations often remain superficial or formal, with technical and engineering-based measures being particularly limited [3].

International research highlights the importance of systematic approaches to school safety. Santa-Cruz et al. [4] underlined that school safety should be considered not only from technical but also from social sustainability perspectives, particularly in risk-prone environments. Similarly, Farewell et al. [5] emphasized that preschool employee safety is directly linked to children's health and the quality of the learning environment. The European Agency for Safety and Health at Work recommends a holistic approach to OHS in schools, covering fire safety, ergonomics, hygiene, energy systems, and emergency management [6].

Fire safety and emergency management constitute a significant part of the literature. Tomluca et al. [7] argued that educational institutions need tailored approaches to emergency and fire preparedness, while Kırtaş and Altundağ [8] demonstrated that structured fire and evacuation training models improve readiness. In the international context, Schildkraut and Nickerson [9] showed that lockdown drills increase school preparedness, and later studies by Schildkraut et al. [10] revealed that educators' perceptions significantly shape the effectiveness of such drills. Ramirez et al. [16] also highlighted that accountability and structured evaluation of emergency drill performance are crucial for effective risk reduction in schools.

The safety of the physical environment and ergonomics are equally critical. Uyal and Umar [13] reported that classroom environments directly influence both academic performance and musculoskeletal discomfort in students. Ramírez-García et al. [14] similarly noted a high prevalence of musculoskeletal disorders among primary school teachers, underlining the importance of ergonomic design in educational facilities. These findings confirm that ergonomics directly affects not only employee health but also the quality of student learning and safety.

Engineering-based approaches are becoming increasingly important in OHS for schools. Çelik [11] showed that the performance of eco-friendly refrigerants in evaporators is directly linked to both energy efficiency and operational safety in HVAC systems. Tirogo [12], in his study on photovoltaic panel tilt angles, highlighted how energy efficiency and electrical safety considerations must be addressed together in school environments. Such findings demonstrate that sustainable energy and safety are interconnected dimensions requiring engineering-based integration. The role of climate change in OHS has also gained prominence in recent years. Feinstein and Mach [15] argued that education plays a crucial role in climate change adaptation by promoting resilience-oriented practices. Environmental stressors such as heat waves and floods directly challenge the safety infrastructure of school buildings, showing the necessity of integrating passive safety measures with energy-efficient systems.

Overall, the literature demonstrates that OHS in educational institutions should not be limited to administrative measures. Instead, engineering-supported solutions are mandatory across multiple dimensions, including fire safety, ergonomics, hygiene, emergency preparedness, sustainable energy management, and climate change adaptation. In this context, this study, through the case of Balahatun Kindergarten, aims to address occupational health and safety in educational institutions from an engineering perspective, filling a gap in both national and international literature.

3. Methodology

This qualitative study examines occupational health and safety (OHS) practices in pre-school education institutions from an engineering perspective. The research was conducted through a case study of Balahatun

Kindergarten. The study examined the school's physical structure, employee safety protocols, and student safety practices in depth.

3.1. Research Design

This research adopted a case study approach. As Yin [17] emphasises, case studies allow for an in-depth understanding of practices within a specific context. Considering the limited number of studies on occupational health and safety (OHS) in educational institutions, particularly in preschool settings [1, 3], the use of this method is especially valuable.

3.2. Data Collection Process

This research utilised three distinct data collection techniques:

- **Observation:** The school's physical environment (classrooms, playgrounds, fire exits, electrical installations, ventilation systems) was directly observed based on engineering criteria. For instance, the placement of fire extinguishers, the functionality of emergency exits, and the safety of electrical outlets were examined in detail [7, 8].
- **Document Analysis:** Risk assessment reports, emergency action plans, and employees' OHS training certificates obtained from the school administration were analyzed. These documents were evaluated within the framework of the OHS Law No. 6331, currently in force in Turkey [2].
- **Interviews:** Semi-structured interviews were conducted with the administrator, teachers, and support staff. These interviews were designed to explore employees' OHS awareness levels, their experiences with emergencies, and their assessments of ergonomic conditions.

3.3. Data Analysis

The data were analysed using thematic analysis and categorised under the following headings:

- **Safety of the Physical Environment:** Structural integrity, safety of electrical and mechanical systems, and fire and evacuation infrastructure [4].
- **Employee Safety:** OHS training for staff, ergonomic practices, and the risk of occupational illnesses [13-14].
- **Student Safety:** Safety of playgrounds, hygienic conditions, and risks of falls and injuries [1, 3].
- **Emergency Management:** Fire drills, crisis scenarios, and the effectiveness of evacuation plans [7-10, 16].

3.4. Limitations of the Study

The study was conducted at a single kindergarten; therefore, the generalizability of the findings is limited. However, as emphasized by Yin [17] and Stake [18], the primary goal of a case study is not generalization but in-depth understanding. Consequently, this limitation does not invalidate the purpose of the study.

4. Findings

This section presents the findings obtained from field observations and document analyses conducted at Balahatun Kindergarten. The results are organised under four main themes related to occupational health and

safety (OHS) practices: the safety of the physical environment; employee safety; student safety; and emergency management. The findings are supported by tables and figures.

4.1. Safety of the Physical Environment

While emergency exit doors are present in the school, observations revealed that the directional signage is inadequate in some areas. While the electrical system is functional, childproof outlets have not been installed in all classrooms. The absence of soft surface material on the playground floor increases the risk of falls. Table 1 provides a detailed summary of these findings.

Table 1. Findings on the safety of the physical environment at Balahatun Kindergarten.

Criterion	Current Status	Deficiency / Risk Area	Literature Support
Emergency exit doors	Present	Lack of directional signage	[4, 7]
Electrical system	Functional	Childproof outlets not in all classrooms	[4]
Playground surface	Hard surface	No soft flooring, high risk of falls	[6, 16]
Furniture	Standard	Missing corner guards	[13, 14]

4.2. Safety of the Physical Environment

It was determined that school employees had received occupational health and safety training. However, interviews revealed that the training had been internalized to only a limited extent in practice. Specifically, ergonomic shortcomings—such as prolonged standing, inappropriate furniture, and heavy lifting—were found to increase the risk of fatigue and health issues among staff.

Uyal and Umar [13] highlight that classroom environments strongly affect both academic outcomes and musculoskeletal discomfort, confirming that inadequate ergonomics can undermine staff and student performance. Similarly, Ramírez-García et al. [14] emphasize that a significant portion of occupational illnesses among school employees stems from ergonomic deficiencies. Furthermore, Farewell et al. [5] revealed a direct link between employee safety and student safety, associating the well-being of staff in preschools with the developmental outcomes of the children.

4.3. Student Safety

It is imperative to note that the kindergarten effectively meets hygiene standards, with restrooms maintained through regular cleaning and the cafeteria consistently upholding rigorous hygiene practices. However, a critical safety concern remains: the absence of soft-surface flooring in high-risk playground areas poses an increased risk to student safety. Additionally, the observation that some classroom furniture lacks corner guards further underscores the need for improved safety measures.

These findings are strongly supported by international research. EU-OSHA (2019) asserts that student safety in preschool institutions is best achieved not only through robust pedagogical strategies but also through intentional physical design and engineering solutions [6]. Ramirez et al. [16] emphasized that conducting regular safety drills and structured evaluations significantly reduces accident risks among students. A comprehensive summary of findings related to both employee and student safety is presented in Table 2, underscoring the urgent need for action in these areas.

Table 2. Findings on the safety of the physical environment at Balahatun Kindergarten.

Criterion	Employee Safety Findings	Deficiency / Risk Area	Literature Support
Training	Provided, but practical application is limited	Insufficient drills for students	[5, 10, 16]
Ergonomics	Prolonged standing, inadequate furniture	Poor playground ergonomics	[13, 14]
Hygiene	Staff hygiene largely maintained	Restroom and cafeteria standards are adequate	[6]
Emergency Preparedness	Extinguishers present, but drills are infrequent	Students have not received regular evacuation training	[7-9, 16]

4.4. Emergency Management

The subject of this section is the management of emergencies. The following essay will provide a comprehensive overview of the relevant literature on the subject.

Despite the presence of fire extinguishers in the building, it was determined that fire drills are performed with low frequency. The absence of adequate emergency directional signage was also a salient issue. This constitutes a risk factor that has the potential to elevate panic levels among students and staff in the event of a crisis.

4.5. General Evaluation

The following essay will provide a comprehensive overview of the relevant literature on the subject. The research findings from Balahatun Kindergarten suggest that the organisation's OHS practices are predominantly oriented towards regulatory compliance and demonstrate an absence of support from engineering-based solutions. The categorisation of the findings is illustrated in Figure 1.

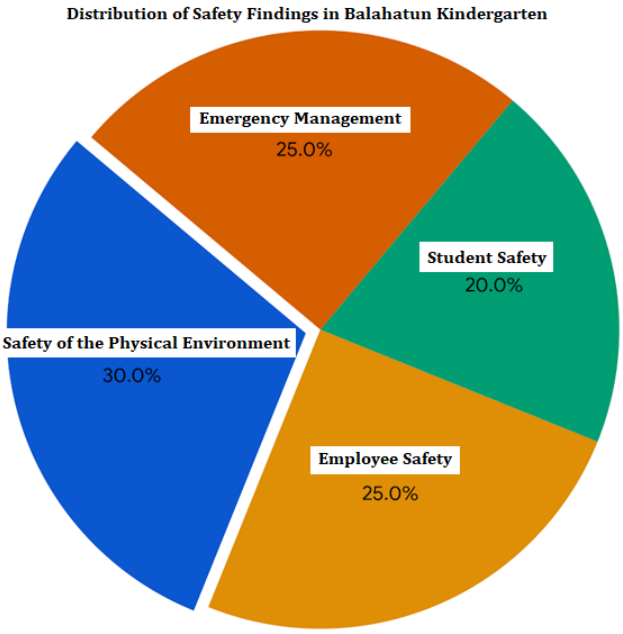

Figure 1. Categorical distribution of occupational health and safety findings at the kindergarten.

5. Conclusion and Recommendations

This study has evaluated occupational health and safety (OHS) practices in preschool education institutions from an engineering perspective, using the case of Balahatun Kindergarten. The findings reveal that while the institution complies with legal regulations, significant deficiencies exist in engineering-based improvements.

- **Safety of the Physical Environment:** Although emergency exit doors are present, directional signage is lacking. While the electrical system is functional, the absence of childproof outlets in all classrooms and the lack of soft-surface flooring in playgrounds pose significant risks to student safety.
- **Employee Safety:** It was determined that staff have received OHS training; however, the practical application of this training is limited. Ergonomic deficiencies, such as prolonged standing and unsuitable furniture, are at a level that could lead to negative health effects for employees.
- **Student Safety:** Hygiene standards have been largely met; however, the lack of corner guards on furniture and the low safety standards of playgrounds pose potential hazards for children.
- **Emergency Management:** It was observed that, while fire-fighting equipment is available, there is a lack of regularity in the conducting of drills, and that directional signage is absent. This is a grave deficiency that has the potential to induce panic and disorientation during a crisis.

Overall, the study demonstrates that OHS in preschools is largely confined to regulatory compliance, and the engineering-oriented safety practices seen in international standards have not yet been sufficiently adopted. This conclusion is consistent with similar findings in the literature. In light of the findings and international literature, the following recommendations have been developed:

- **Physical Environment Modifications:** Expanding the use of childproof outlets in classrooms, covering furniture corners with protective materials, and making the use of soft-surface flooring in playgrounds mandatory.
- **Ergonomic Improvements:** Providing ergonomic furniture for teachers and staff, balancing work schedules, and implementing regulations to reduce the risk of occupational illnesses.
- **Drills and Awareness-Raising:** Conducting regular fire, earthquake, and evacuation drills appropriate for students' age groups; developing safety awareness programs for teachers and parents.
- **Hygiene and Health Measures:** Regularly inspecting cafeteria and restroom hygiene, and increasing hygiene education for children to prevent the spread of infectious diseases.
- **Engineering-Oriented Risk Analysis:** Basing risk assessments in preschools not only on administrative reports but also on engineering-based measurements (e.g., electrical tests, structural integrity analyses, ergonomic evaluations).
- **Climate Change Adaptation:** Integrating passive safety measures, energy-efficient HVAC systems, and sustainable design solutions to counter environmental threats such as extreme heat and flooding.

In conclusion, the case of Balahatun Kindergarten demonstrates that while OHS practices exist within a legal framework in preschools, there is a clear need for a holistic, engineering-supported approach. Future research could contribute to the development of OHS standards in educational institutions by conducting similar field studies with larger sample groups.

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Conflicts of interest
The authors declare no conflicts of interest.

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